A pandemic summer: Impact on teaching and learning for mastery in Power Maths primary schools

Jennie Golding[1], Grace Grima[2]

[1]*UCL Institute of Education,* [2]*Pearson UK*

We report on findings from a 2019-2021 study of use and impact of Power Maths, a 'mastery'-oriented primary (R-year 6) resource. The study follows 40 classes of 2019-20 Power Maths-using year 1,3 and 5 children and their teachers over two years, exploring teacher/pupil use and impact on learning. We report initial high-level findings. Summer 2020 study data serendipitously enabled us to understand aspects of teachers' work over the pandemic period. Teachers reported particular challenges in addressing new areas requiring conceptual development, and inability to effectively develop children's mathematical language or reasoning, or to monitor deep progress in mathematics learning. However, some children's learning benefited from small group in-school provision, and others' from more contextualised and less time-constrained 'home schooling'. Tentatively, children returning to school often showed initially slow, but accelerating, recovery from confidence and learning loss.

Keywords: primary mathematics; mathematics mastery; pandemic learning; home schooling.

Introduction: the policy and pandemic contexts

The 2014 mathematics national curriculum for 5-16 year olds in England (DfE, 2013) features a renewed emphasis on mathematical communication, problem solving and reasoning. In parallel, the Department for Education (DfE) invested heavily in developing 'mastery' approaches to teaching and learning mathematics adopted in several high-performing jurisdictions (e.g. OECD, 2012). As part of that initiative they match-funded school purchase of primary (R-year 6, 4-11 year olds) curriculum resources aligned with such approaches, including Pearson's 'Power Maths', available from 2018. This paper draws on data from a study of teachers and children in Power Maths schools. 'Mastery' of mathematics is interpreted variously, but a common goal is that children should come to work mathematically with confidence, flexibility, reliability and efficiency, underpinned by deep conceptual grasp. Approaches thought to support such learning in high-performing jurisdictions and reflected in Power Maths plans, structures, and teacher materials, include

- Interactive, inclusive whole-class teaching that capitalises on use of physical manipulatives and iconic representations, supporting link-making between those and related concepts;
- use of deliberate conceptual and procedural variation, and carefully-developed challenging and reflection-promoting questions, to assess, promote and support fluency and deep understanding, including of mathematical structures;
- direct discussion of errors and misconceptions as support for learning;
- promotion of same-day intervention to promote firm foundations for all (Hodgen et al., 2018). Boylan, M., Maxwell, B., Wolstenholme, C., Jay, T., & Demack, S. (2018). The Mathematics Teacher Exchange and 'Mastery' in

England: The Evidence for the Efficacy of Component Practices. Education Sciences, 8(4), 202.

It is known that the impact on learning is culturally-dependent so does not necessarily transfer across cultures unproblematically; further, these approaches draw on skilled, subject-knowledgeable teaching (e.g. Pepin et al., 2016) that is necessarily rich in formative assessment. In England primary teachers are not usually mathematics specialists, so as a minimum, the provision of teacher-educative resources (Davis & Krajcik, 2005), and/or other sustained professional development to support such teaching, is important if intentions are to be realised. Here, we evidence progress towards such approaches supported by Power Maths materials to March 2020.

However, in March 2020, in response to Covid19, all schools in England closed to most pupils until at least June, and for many pupils, September. Schools, teachers and families had to formulate their response in a rapidly changing and unprecedented scenario. We report on ways that primary teaching and learning for mathematics 'mastery' was disrupted during this time. We contextualise this within evidence from the preceding part of the study, comprising a pilot study (13 year 1-3 classes) in 2018-19 and the first two terms of the full study with 40 year 1, 3 and 5 classes and their teachers in September 2019-March 2020.

The impact of such school closures is poorly understood: earlier evidence is largely of much shorter, andgenerally planned, closures. Disadvantaged children are likely to lose learning disproportionately (Education Endowment Foundation, 2020). In most primary schools in England, unlike some other jurisdictions (e.g. Drijvers, 2020), it was not possible to establish sustained remote teaching and learning (Eivers et al., 2020). Early evidence suggests a complex picture of provision for primary children in England, with foci well beyond academic learning (e.g. Moss et al., 2020). This paper offers early mathematics-specific evidence of the impact of the move.

Research questions and theoretical frameworks

We draw on findings from a two-year study (2019-2021) conducted by Pearson in collaboration with UCL. Field researchers are experienced subject- and phase-specialists independent of Pearson. We adopted an institutional ethnographic approach (Smith, 2005) in an effort to understand the lived experiences of teachers' and children's early use of Power Maths and the impact on mathematics learning. In summer 2020, research questions focused on those areas were expanded in scope to capture emerging impacts of school closures in response to Covid19:

1. How did these teachers set out to provide for children's mathematics learning over the home-schooling period?
2. What resources did they use, why, and what was the perceived impact of their approach?
3. What were teachers' mathematics plans and needs for Autumn 2020?

We focus here on high-level responses to these questions, contextualising those within earlier study data.

Methodology

As indicated in Table 1 which outlines data collection for the first year of the full study, each yearly cycle comprises three phases, collecting largely primary data from two classes in each of 20 fairly representative primary schools. Standing alone, surveys are not ideal for institutional ethnographic purposes, but well-established

relationships with teachers supported rich and often extensive survey responses following more direct engagement via interviews and observations.

Table 1: Data collection in 2019-20

Phase 1: Autumn 2019	- results from 40 classes of year 1,3 or 5 baseline assessments - Transcriptions of interviews with 40 year 1,3 or 5 class teachers and 6 other school mathematics coordinators (MCs).
Phase 2: Spring 2020 (school visits, curtailed by pandemic)	- Plans and observation notes from 34 whole lesson observations - 34 post-observation class teacher and 2 other MC interview transcripts - 34 children's post-observation focus group transcripts - 17 sets of visit notes
Phase 3: July 2020	- completed surveys from 36 class teachers and 4 school mathematics coordinators - transcripts of 17 school MC interviews

The sample was drawn from Power Maths schools approached purposively and willing to participate. However, it has reasonable representativeness in aspects known to affect teaching and learning, such as size, recent inspection outcomes, socio-economic status of catchment area and children's previous attainment levels. Following the pilot study in six schools, we collected data from the mathematics coordinator and from teachers and children in classes in two of years 1, 3 and 5, in each of 20 schools. In year 2 (2020-21) we are following those classes into years 2, 4 and 6. All interviews were recorded and transcribed; all qualitative data were then iteratively analysed by research question and then using an open grounded approach (Charmaz, 2006) to expose sub-themes. In parallel, documentary analysis of lesson plans, the Power Maths materials used, and other local documents were analysed in an attempt to understand enactment with an 'institutional ethnographic' lens (Smith, 2005): data could then be interpreted within a much wider grasp of schools' personnel, and in-school and broader working context/constraints.

Findings

Pilot and main study findings to March 2020 indicated (Golding, Barrow & Grima, 2020) that where teachers had made significant investment in getting to know, and work with, the materials, including teacher support, observations commonly showed apparent direct impact on classroom practice and attempts to support inclusive mastery. Enhanced such practice was particularly well-supported where there was sustained in-school collaborative, materials-focused development led by a subject-knowledgeable teacher. Those teachers reported medium-term gains of improved professional practice, reduced preparation time, and more deeply-rooted learning progress: early observations supported such claims. They were confident teachers and children would make further progress with more experience of Power Maths. Focus groups with their children of varying prior attainments showed encouraging evidence of progress towards the target 'mastery', and some shrinking of 'attainment gaps', although a few persistently low-attaining learners often remained a concern in this early use of Power Maths. Overall, though, the 'whole-class mastery' approach was being implemented with varying degrees of fidelity to intentions: only about half of study classes were making such sustained progress towards intentions, with limited subject and subject pedagogical grasp still an apparently significant impediment:

> Not all teachers used manipulatives as intended, for example, one Y1 teacher was seen using bead strings to teach bridging tens, but failed to capitalise on the tens structure of the bead string *(Visit notes 13, Spring 2020);*
> Children's focus (and teacher's for much of lesson) was on formal written division at the exclusion of opportunities to develop reasoning around division/remainders (*y5 lesson observation 10, Spring 2020*)

Selection from materials remained variably-coherent, unsurprisingly for non-specialist teachers, and materials are being developed to better support informed selection. However, many children and teachers reported believing they had gained in positive affect:

> Almost all children I talked to were confident they were getting better at maths, could give convincing examples of that, and were enthusiastic about their lessons and the challenge of Power Maths (*Visit notes 8, Spring 2020*).

Once schools closed, though, it was rare for teachers to attempt to maintain the usual depth and pace of Power Maths; they typically initially majored on procedural consolidation because of the limits to expectations of parental support:

> Our head teacher …didn't want us to do any new learning at that point because she didn't want to stress any of the parents out. So it was literally just going to be five maths tasks that were just revising previous knowledge *(MC7, July 2020);*
> How we use Power Maths …is there's so much discussion happening… if the parents had to do that, if they weren't able to discuss it, or the discussion wasn't led in the correct way, they'd probably do more harm than good *(MC13, July 2020);*
> Year 3 was just about to start fractions and we didn't want to have to burden parents with that or have to unpick it all when they come back *(MC16, July 2020).*

Once it became clear closures were to be extended, teachers attempted organisation for new learning, usually through self-contained videos and highly-structured stand-alone presentations, or printed materials: Power Maths resources were commonly reported to be felt too demanding for remote learning, though about a third adopted Power Maths materials specially adapted (and reduced) for the situation. Most schools prioritised literacy, with much reduced, and often flexible, mathematics expectations:

> We focused on suggestions for practical tasks in measures, time and money that would be part of cooking, shopping and making things. Growing and measuring sunflowers was popular. We gave a variety of options weekly to try and encourage participation *(Y1 teacher5, July 2020).*

During closure, no sample teacher had regular live first teaching time with children: live contact was focused on children's wellbeing and, on parental request, troubleshooting emerging learning challenges, though such interventions were rarely achievable on the same day.

In July 2020, teachers reflecting on closures reported challenges in addressing new areas requiring conceptual development, and an inability to effectively develop children's mathematical language or reasoning, or to monitor deep progress:

> Lack of access to a teacher who can probe or tackle misconceptions…no opportunity to work with concrete manipulatives or probe reasoning, which would help massively in fostering sound understanding *(Y5 teacher 15, July 2020).*

They reported many children had been able to access only some of the recommended materials, whether because of limited access to technology or internet, or pressures on or limited confidence of parents. School level provision had usually been tailored to

knowledge of the families concerned, and children's subsequent access was generally thought to have no simple relationship with socio-economic background. Assessment had usually been restricted to children's engagement, rather than their learning, but even engagement proved problematic:

> It started really well but dropped to about 30% of the Year 5 cohort consistently accessing maths lessons – some didn't ever. Some units were …too long for their motivation and they found it difficult. Again, parent confidence seemed a big factor in this (*Y5 teacher12, July 2020*).

A minority of children, though, had reportedly thrived on more contextualised and less time-constrained work at home, gaining confidence to work/think independently, and teachers valued enhanced partnership with some parents during closures. They also reported vulnerable and 'key worker' children having thrived on the small group learning they had continued to experience in school:

> I have this small group of new children now: with that extra attention and less pressure on pace they've realised it can make sense and they can let go of what to do and really think with, and enjoy, the ideas *(MC2, July 2020).*

If children returned to school for a short period before the summer break, teachers generally focused on wellbeing and re-preparation for learning rather than curriculum coverage. They did not attempt to re-establish Power Maths structures and aspirations, but had a widespread priority of maintaining parity of exposure/pace with children still learning at home. Within children returning, attainment and confidence gaps were commonly reported to have widened: 'All of their confidence has gone down a little bit, and for some children that haven't accessed anything, quite considerably' *(MC13, July 2020).* 'Mastery' approaches had also dissipated:

> Children have been less keen to try things and seem more worried about getting things wrong. They are asking for help much quicker than they did in the classroom when we could encourage them to think about the problem and try different ways of solving the problem *(Y5 teacher4, July 2020);*
> …We're back to the old style, the answer's the important thing, and if I haven't got the answer, it's wrong. So, those Discover tasks have been immensely important with the Year 6s, to get them back into realising it's not just about finding the answer *(MC14, July 2020).*

Teachers usually aimed to address such issues within future planned learning, but recognised the demanding nature of such teaching. However, where, unusually, children had returned for several weeks before summer closures, teachers reported they often showed initially slow, but accelerating, recovery from confidence and learning loss. No teachers intended to resume full use of Power Maths immediately on return to school in September, citing a pressing need for a 'recovery curriculum'. They expected the academic year from September 2020 to bring severe constraints on mastery-valued practices such as use of manipulatives and other shared resources, and close physical contact with children's work that supports effective formative assessment. They also expected further disruption to usual teaching and learning, so planned to continue use of many materials familiar from home schooling.

Discussion

Teaching for the target mastery is demanding, but this study shows sustained engagement with high-quality teacher-educative materials, and professional

collaboration focused on that, can help. However, during school closures limited live teaching, constraints on face to face work, insecurity about further disruptions to usual practice, and widening attainment gaps militated against many practices identified with the target mastery. Primary school strategies were highly framed by teachers' knowledge of their children, families and contexts, and children's learning opportunities necessarily very dependent on parents or other carers. Experiences reported here for years 1,3,5 and beyond are consistent with emerging generic studies (e.g. Eivers et al., 2020; Moss et al., 2020), showing complex responses tailored to local needs, but they offer details of particular impacts on mathematics teaching and learning. Positively, teachers did report enhanced working relationships with some parents, and some children gaining from in-school small group provision, or at-home contextualised and less time-constrained mathematics work.

However, degrees and nature of specific mathematics learning gaps, their origin and persistence, good ways to address those, and teacher/child learning gains from the home-schooling period, are still to be widely explored: this study will do so in 2020-21. The work to date suggests that primary mathematics conceptual, language and reasoning development, fundamental to mastery, are challenging to achieve remotely, and especially without synchronous teaching, since responsive interactions are very limited. Formative assessment is then of work submitted, without knowing the role of parents or others in the production of that work. Most teachers will have to re-establish their own, and children's, ways of working towards mathematics mastery.

Acknowledgement: This paper draws on research funded by Pearson UK.

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